Wells Avenue Traffic Study

Four-to-Three Lane Conversion

Final Report

Submitted to

The Regional Transportation Commission of Washoe County

Submitted by

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EXECUTIVE SUMMARY

This report addresses the changes in traffic characteristics along a segment of Wells Avenue in City of Reno due to a modification of the roadway cross section. In 2003, a segment of the roadway on Wells Avenue was changed from two lanes each direction to one lane each direction with an added center two-way left-turn lane, bike lane and wider sidewalks while maintaining the on-street parking. Traffic crashes, traffic volumes, traffic speeds and pedestrian crashes were collected during the periods before (2001-2002) and after the conversion (2005-2006 for traffic crashes[1], and 2007 for volume and speed). Comparisons were made among these traffic flow characteristics. The study reached the following major findings:

Traffic Crashes

- The number of crashes was significantly reduced after the roadway conversion based on the two-year before and two-year after analysis periods. The total number of crashes decreased from 123 before the conversion to 85 crashes after the conversion (an overall reduction of about 31%).
- The most crash reductions were in the categories of rear-end, angle, and overtaking sideswipe. These also appeared to be the most common types of crashes on this roadway segment. The separation of directional traffic and speed drop seemed to contribute the most to the crash reductions.
- The modified roadway configuration created a safer pedestrian environment evidenced by the decrease of pedestrian crashes. There was a slight increase in crashes at the roundabout location after the roadway modification project (from zero to three crashes). Although the slight increase may be explained by driver's inexperience and confusion at newly installed roundabouts, the small sample is not sufficient to draw definitive conclusions.

Traffic Volumes

[1] Only two-year after crash data was available at the time of the study.

- In general, traffic volumes were reduced after the roadway conversion. At the location near Taylor Street, the Average Daily Traffic (ADT) volume dropped from 15,854 to 14,244, which was about 10 % reduction.
- At the locations near Burns Street and Thoma Street, the ADT volume reductions were about 4% and 15.6%, respectively. The ADT volume reduction for both locations was about 10.3%.
- The traffic volume reductions suggest that there has been a shift in traffic demand from Wells Avenue to other nearby arterials due to the change in roadway configuration. The study indicted that the traffic volume shift mainly occurred on Virginia Street.

Level-of-Service

- The LOS did not seem to be affected due to the roadway conversion.

Traffic Speeds

In general, traffic speeds also decreased after the roadway conversion. The speed reductions ranged between 5 mph and 9 mph, or about 14% to 24%.

INTRODUCTION

In 2003, a roadway segment between Stewart Street and South Virginia Street along Wells Avenue in Reno, Nevada was changed from two lanes each direction (NB & SB) to one lane each direction with an added two-way left-turn lane (See Figure 1). This report documents the changes in traffic flow characteristics due to the roadway modification. A before-after study was conducted to demonstrate the changes in traffic crashes, vehicle speeds, and traffic volumes.

The analyses documented in this report were based on data during the periods before and after the roadway modification. Traffic crashes, speeds, and traffic volumes for the before case (2001-2002) were obtained from previous studies conducted by Kimley-Horn and Associates. Traffic crash data for the after case was collected for the years of 2005-2006, while the speed and volume data was collected in 2007 at identical locations.

TRAFFIC CRASHES

The crash data for the study roadway segment on Wells Avenue was obtained from the Nevada Department of Transportation (NDOT). A comparison was made between the average number of crashes over a two-year before period (2001-2002) and a two-year after period (2005-2006). It was found that the total number of crashes decreased from 123 before the conversion to 85 crashes after the conversion (about a 31% overall reduction, See Table 1).

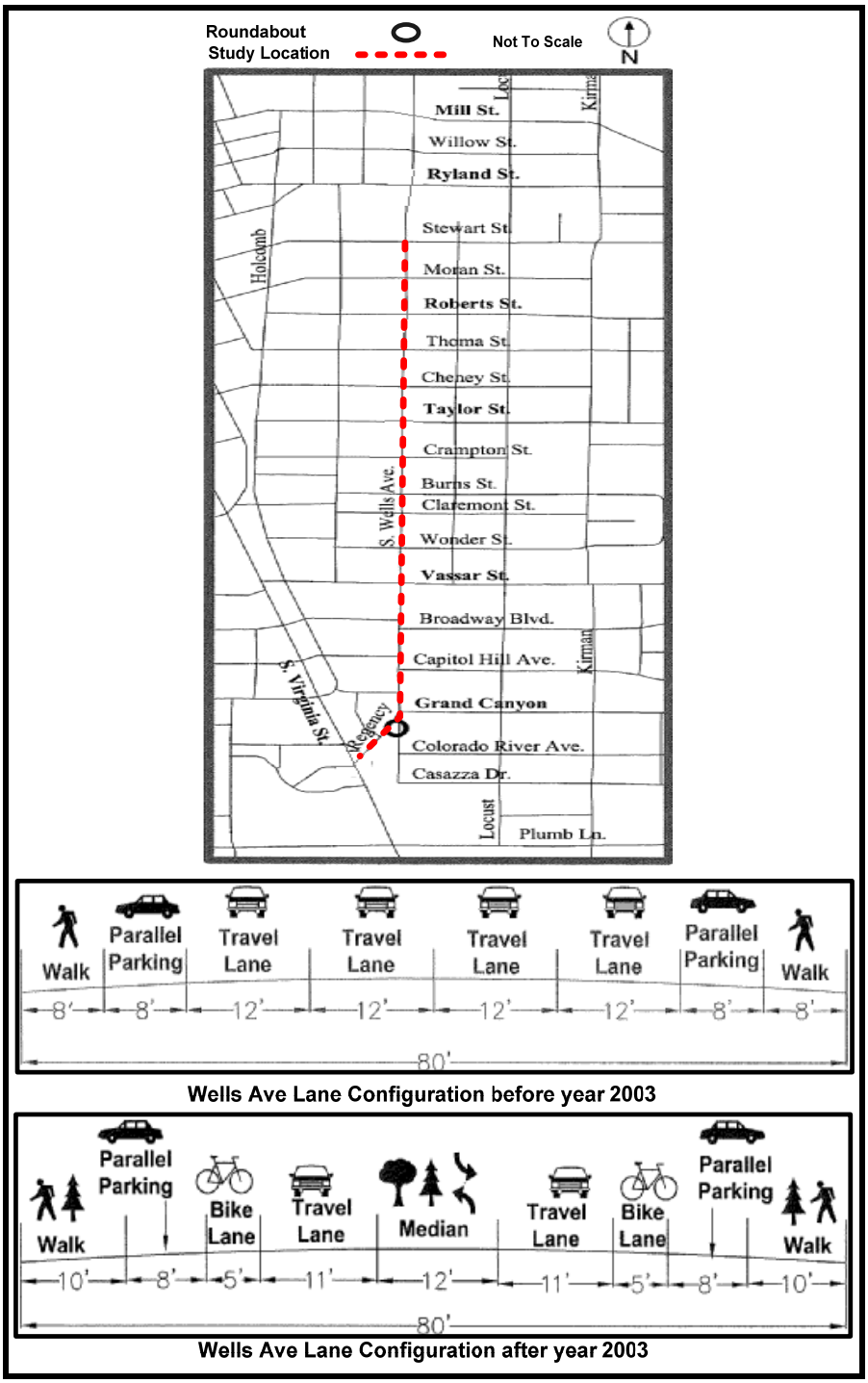

Figure 1: Study Site and Roadway Cross Sections

Table 1: Before and After Crash Data

Location	Before (B) (2001-2002)	After (A) (2005-2006)	Difference (A-B)	%Change
ARROYO ST.	0	3	3	NA
BROADWAY BLVD.	9	3	-6	-67
BURNS ST.	6	5	-1	-17
COLORADO RIVER BLVD.	0	3	3	NA
CAPITOL HILL AV.	5	1	-4	-80
CASAZZA DR.	1	3	2	200
CHENEY ST.	13	4	-9	-69
CLAREMONT ST.	6	2	-4	-67
CRAMPTON ST.	6	4	-2	-33
GRAND CANYON BLVD.	4	1	-3	-75
MORAN ST.	10	5	-5	-50
PUEBLO ST.	4	5	1	25
REGENCY WAY	0	3	3	NA
ROBERTS ST.	8	4	-4	-50
STEWART ST.	9	11	2	22
TAYLOR ST.	8	8	0	0
THOMA ST.	9	2	-7	-78
VASSAR ST.	19	8	-11	-58
VESTA ST.	1	3	2	200
VIRGINIA ST.	2	1	-1	-50
WONDER ST.	3	6	3	100
Overall	**123**	**85**	**38**	**31**

Note: Positive indicates increase, negative indicates decrease.

Table 2 includes the number of crashes by types. As can be seen, rear-end crashes continued to be the most common with 52 crashes before the conversion and 42 crashes after the conversion (18% reduction). Most rear-end crashes were between vehicles going straight, but the crashes were not concentrated at particular locations. The second most common crash type was angle crashes. A reduction on angle crashes was about 42%. Overtaking sideswipe crashes also showed a significant reduction (69%).

The significant reductions on rear-end and sideswipe crashes along the study segment seemed to be contributed by the separation of traffic and reduced speeds after the roadway conversion. The roadway conversion also seemed to be effective in improving side street safety as indicated by the significant reduction on angle crashes. The pedestrian crashes (primarily listed under the B – Non Collision category) also dropped

by 54%, indicating that the roadway modification significantly improved pedestrian safety.

Table 2: Crashes by Types

Crash Type	Before (B) (2001-2002)	After (A) (2005-2006)	Difference (A-B)	%Change
A – Angle	33	19	-14	-42
B – Non Collision	13	6	-7	-54
C – Rear End	52	43	-9	-18
D – Sideswipe, Overtaking	13	4	-9	-69
E – Head On	0	2	2	NA
F – Sideswipe, Meeting	0	3	3	NA
G – Rear-to-rear	0	1	1	NA
H – Backing	0	2	2	NA
I – Unknown	12	5	-7	-52
Sum	**123**	**85**	**38**	**31**

Note: Positive indicates increase, negative indicates decrease.

Table 3 lists the before and after crashes by intersection and by crash type. Again, most crash reductions were in the categories of rear-end, angle, and overtaking sideswipe. Traffic crashes increased from zero to three at the roundabout location (listed under Regency and Wells Ave). The roundabout was built during the period when the roadway was re-configured along Wells Avenue. The three crashes included one angle crash, one non-collision crash, and one rear-end crash. While the data was not sufficient to draw statistically significant conclusions, the crashes may be caused by driver's confusion and inexperience of using roundabouts since implementation of roundabouts in the Reno area only occurred recently.

Table 3: Crashes by Type and Intersection

Location/Crash Type	Before (B) (2001-2002)									After (A) (2005-2006)								
	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
ARROYO ST.											1	1	1					
BROADWAY BLVD.	3		6									2		1				
BURNS ST.	1	1	3	1							1	1			1		1	1
COLORADO RIVER BLVD												1				1		1
CAPITOL HILL AV.	2	1		1					1						1			
CASAZZA DR.		1										1	1				1	
CHENEY ST.	1	2	9	1						1	1	2						
CLAREMONT ST.	2		3	1									1					1
CRAMPTON ST.	4		1	1						2		2						
GRAND CANYON BLVD.	2		2								1							
MORAN ST.	2	1	6						1			3		1				1
PUEBLO ST.	1		1	1					1	1		4						
REGENCY WAY										1	1	1						
ROBERTS ST.	3		3	1					1			4						
STEWART ST.	1		7	1						6		4	1					
TAYLOR ST.	1	3	2	1					1	4		4						
THOMA ST.	1	2	3						3			2						
VASSAR ST.	6		5	4					4	3	1	3			1			
VESTA ST.	1											2						1
VIRGINIA ST.		2								1								
WONDER ST.	2		1									6						
Sum	33	13	52	13	0	0	0	0	12	19	6	43	4	2	3	1	2	5
Total	123									85								

TRAFFIC VOLUMES

The traffic volumes for the before period (year 2002) were based on a study by Kimley-Horn and Associates. The study included traffic volume data collected in August 2002 at certain locations along the roadway segment where the roadway cross section was changed. The data collection locations included Taylor Street, Burns Street, and Thoma Street. The traffic volumes for the after period were collected in December 2007 at the same locations. Both traffic volumes were adjusted using NDOT's seasonal adjustment factor to compensate for the effect of monthly traffic volume variations. The before (Kimley-Horn) traffic volumes were multiplied by a seasonal adjustment factor of 0.961 (for August) and the after traffic volumes were multiplied by a seasonal factor of 1.0 (for December). At the location near Taylor Street, traffic volumes were collected

continuously for one week and the average daily traffic (ADT) volumes were calculated (See Table 4). It was found that the ADT volume dropped from 15,854 to 14,244 which is about 10 % reduction.

Table 4: One-Week Traffic Volume Counts near Taylor Street

	Wells near Taylor		
	Before (B) (2002)	**After (A) (2007)**	**Change (A-B)**
Monday	17,256	15,751	-1,505
Tuesday	17,575	14,210	-3,365
Wednesday	15,844	13,614	-2,230
Thursday	17,248	13,319	-3,929
Friday	18,457	17,041	-1,416
Saturday	13,833	14,589	756
Sunday	10,766	11,183	417
Averages	**15,854**	**14,244**	**-1,610**
Average Volume Reduction			**-10.0%**

Note: Negative indicates reduction

At the locations near Burns Street and Thoma Street, traffic volumes were available for only two weekdays (Tuesday and Wednesday) during the before period. Therefore, traffic counts were only collected on Tuesday and Wednesday at these locations for the after period. The results are summarized in Table 5. It was found that traffic volumes decreased at both locations after the roadway conversion. The average daily volume reductions at Burns St. and Thoma St. locations were 4% and 15.6%, respectively. The average daily volume reduction for both locations was about 10.3%, which was similar to that found at the Taylor Street location.

Table 5: Two-day Traffic Volume Counts near Burns and near Thoma

	Before (B)		After (A)		Change (A-B)		
	Tue (8/06/02)	**Wed (8/07/02)**	**Tue (12/04/07)**	**Wed (12/05/07)**	**Tue**	**Wed**	**Average**
Burns St.	18,180	18,298	17,546	17,459	-634 (3.5%)	-839 (4.6%)	-736 (4%)
Thoma St.	20,538	22,440	17,957	18,267	-2,581 (12.6%)	-4,173 (18.6%)	-3,377 (15.6%)
Average	19,359	20,369	17,752	17,863	-1,607 (8.3%)	-2,506 (12.3%)	-2,057 (10.3%)

Note: Negative indicates reduction

The traffic volume reductions suggest that there had been a shift in traffic demand from Wells Avenue to other nearby arterials due to the roadway configuration change. The volume reduction was reflected even with the fact that the after period traffic volume was collected five years later, when traffic volumes were expected to increase for the region due to normal growth.

To further investigate the reasons behind the volume reductions along Wells Avenue, traffic volumes at the nearest parallel arterial streets were compared to see if there had been any sudden increase in traffic volumes right after the roadway modification. The two selected arterial streets are Virginia Street and Kirman Street. The Average Annual Daily Traffic (AADT) volumes were obtained from the Nevada Department of Transportation (NDOT) for the periods before and after the roadway modification project. The AADTs were available at the two locations on each parallel arterial shown in Figure 2. These two locations were upstream (North) of the roadway segment where the roadway modification was done; therefore, any diverted traffic should be reflected at these two locations.

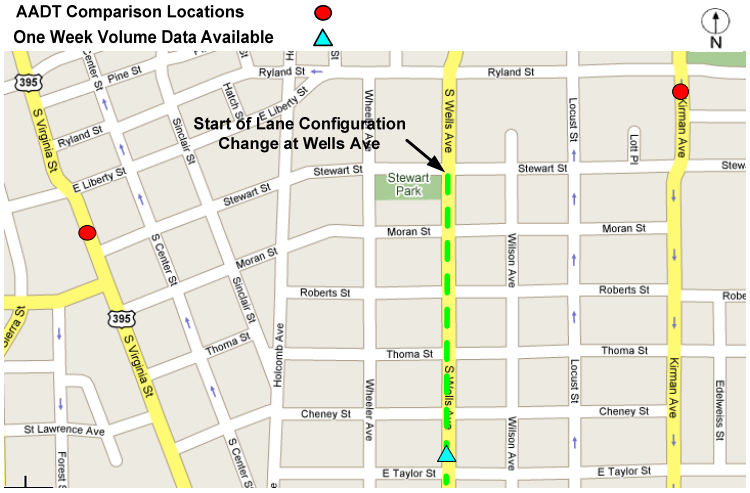

Figure 2: AADT Comparison Locations and One Week Volume Data location

The AADTs (from 1997 to 2006) at the Kirman Street location (Kirman South of Ryland) are shown in Figure 3. By examining the one-year before and one-year after the project year, it actually showed a decrease in traffic volumes after the project. The reason behind this traffic volume drop was not immediately known, but was suspected to be caused by any roadway work on Kirman Street. This claim is supported by traffic volume increase

for the years of 2005 and 2006; however, the increase seemed to reach the same level as year 2002, indicating that the sudden drop in 2004 was just temporary. It was concluded that there was no apparent traffic volume increase on Kirman Street after the roadway modification project on Wells Avenue.

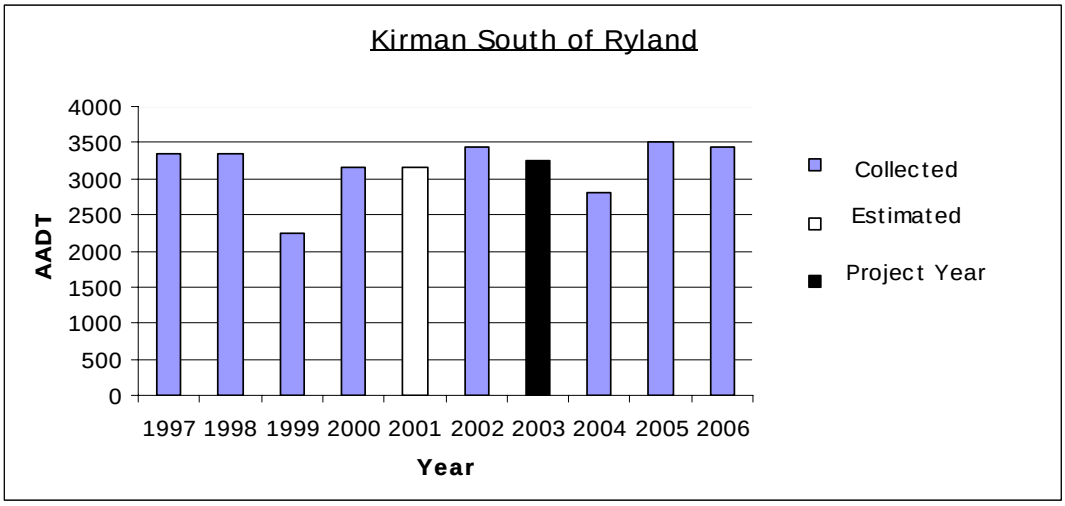

Figure 3: AADT Comparison at Kirman South of Ryland

The AADTs at the South Virginia Street location (S. Virginia North of Stewart Street) are shown in Figure 4. The traffic volume increase can be clearly seen from the figure after the Wells Avenue project. The AADT increased from 18,500 vehicles per day in 2002 to 21,300 vehicles per day in 2004, a net increase of 2,800 vehicles per day. The AADTs almost remained constant for the following years (2005 and 2006). The result seems to support the hypothesis that there is a shift of traffic demands from Wells Avenue to Virginia Street due to the roadway modification project.

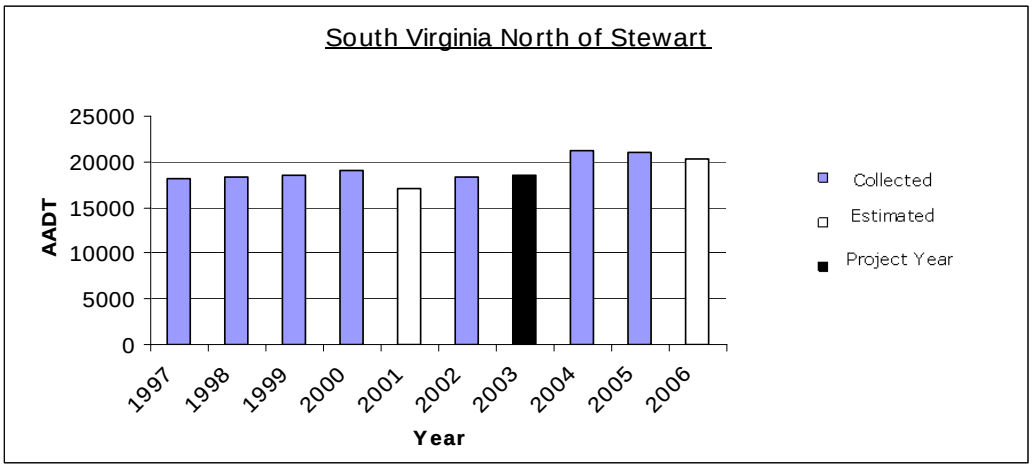

Figure 4: AADT Comparison at South Virginia North of Stewart

LEVEL-OF-SERVICE

A general concern on converting from a four-lane undivided roadway to a three-lane arterial is the degradation of arterial level-of-service (LOS) and increased delay and travel time. However, both research and field case studies have shown that the change of LOS would become significant only if the AADT is greater than approximately 17,500 vpd. The actual AADT threshold could also be affected by other factors, such as higher percentage of trucks and the existence of bus stops. As for the case of Wells Avenue, the AADT was found to be reduced after the roadway conversion, and both the before and after AADTs were less than 17,500 vpd (see Table 5). The percentage of trucks and the number of bus stops were also considered moderate to low based on field observations. Therefore, the LOS did not seem to be affected due to the roadway conversion.

There are other reasons that could explain why the LOS would not change significantly due to the roadway conversion. One fact is that the arterial LOS is mainly controlled by the critical intersections along an arterial, especially at signalized intersections. At signalized intersections, the LOS is largely affected by the left-turn volumes. Converting from four-lane to three-lane would maintain an exclusive left-turn lane, which would be equivalent to the defacto left-turn lane under the four-lane case. At unsignalized intersections, on the other hand, the LOS can actually be improved due to the exclusive two-way left-turn lane to better serve both the main-street left-turn traffic and the side-street left-turn traffic.

It should be noted that the arterial LOS should not be evaluated simply based on the travel speeds. A reduced speed is preferred from the safety point of view, but not an indication of LOS degradation. As long as the critical intersections operate at an acceptable LOS, reduction of speed should not affect the overall corridor LOS. Although a before-after analysis was not conducted to compare the intersection LOS (due to lack of before turning movement counts), field observations did not reveal any operational concerns at the critical intersections.

SPEED STUDY

The speeds for the before period (year 2002) were also based on the study by Kimley-Horn and Associates. Both the 50^{th} and 85^{th} percentile speeds were reported at certain locations along the road segment under study. There were two locations where speeds were measured. These locations included Taylor Street (one week data, both directions); the segment between Crampton Street and Taylor Street (southbound at 12:00 PM on Tuesday; and northbound at 12:30 PM on Wednesday). Speeds for the after period were collected in 2007 at the same locations and during identical weekdays and time periods. The results are summarized in Tables 6 and 7.

Table 6: One-week Vehicle Speeds at Taylor Street Location

	Before (B) (2002)		**After (A) (2007)**		**Change (A-B)**	
	50th % (mph)	**85th % (mph)**	**50th % (mph)**	**85th % (mph)**	**50th % (mph)**	**85th % (mph)**
Monday	32.9	38.8	26.6	30.2	-6.3	-8.6
Tuesday	33	38.9	27.6	31.5	-5.4	-7.4
Wednesday	33	38.9	26.6	31	-6.4	-7.9
Thursday	33.1	39	26.6	31	-6.5	-8
Friday	32.7	38.7	26	30.2	-6.7	-8.5
Saturday	33.1	39.1	26.6	31	-6.5	-8.1
Sunday	33.6	39.4	27.2	31	-6.4	-8.4
Average	**33.1**	**39.0**	**26.7**	**30.8**	**-6.4 (19%)**	**-8.2 (21%)**

Note: Negative means reduction

Table 7: Two-day Vehicle Speeds between Crampton Street and Taylor Street

	Before (2002)		After (A) (2007)		Change (A-B)			
	SB Tue 04/16/02	NB Wed 05/01/02	SB Tue 11/27/07	NB Wed 11/28/07	SB	NB	SB	NB
50th % Speed (mph)	33	32	25	27	-8	-5	-24%	-16%
85th % Speed (mph)	37	36	28	31	-9	-5	-24%	-14%

Note: Negative means reduction

From Table 6, it can be seen that both the 50th and 85th percentile speeds dropped after the roadway modification. The average 50th and 85th percentile speeds for the entire week dropped from 33.1 and 39.0 mph to 26.7 and 30.8 mph, respectively. This represented a reduction of about 19% and 21% for the 50th and 85th percentile speeds, respectively.

From Table 7, it can be seen that the speeds also dropped in both directions at the segment between Crampton Street and Taylor Street. Southbound, the 50th percentile speed dropped from 33 mph to 25 mph and the 85th percentile speed dropped from 37 mph to 28 mph, both representing about a 24% reduction in speeds. Northbound, the 50th percentile speeds were reduced by 16%, from 32 mph to 27 mph. The 85th percentile speed dropped from 36 mph to 31 mph, which was about a 14% reduction.

SUMMARY AND FINDINGS

Traffic crashes, traffic volumes, and traffic speeds were collected and compared for the periods before and after the roadway modification was made on Wells Avenue. Based on the analyses conducted in this study, the following conclusions were reached:

Traffic Crashes

- The number of crashes was significantly reduced after the roadway conversion. The total number of crashes decreased from 123 before the conversion to 85 crashes after the conversion (an overall reduction of about 31%).
- The most crash reductions were in the categories of rear-end, angle, and overtaking sideswipe. These also appeared to be the most common types of crashes on this

roadway segment. The separation of directional traffic and speed drop seemed to contribute the most to the crash reductions.

- The modified roadway configuration created a safer pedestrian environment evidenced by the decrease of pedestrian crashes. There was a slight increase in crashes at the roundabout location after the roadway modification project (from zero to three crashes). Although the slight increase may be explained by driver's inexperience and confusion at newly installed roundabouts, the small sample is not sufficient to draw definitive conclusions.

Traffic Volumes

- At In general, traffic volumes were reduced after the roadway conversion. At the location near Taylor Street, the ADT volume dropped from 15,854 to 14,244, which was about 10 % reduction.
- At the locations near Burns Street and Thoma Street, the average daily volume reductions at Burns St. and Thoma St. locations were 4% and 15.6%, respectively. The average daily volume reduction for both locations was about 10.3%, which was similar to that found at the Taylor Street location.
- The traffic volume reductions suggest that there has been a shift in traffic demand from Wells Avenue to other nearby arterials due to the change in roadway configuration. The study indicted that the traffic volume shift mainly occurred on Virginia Street.

Level-of-Service

- The LOS did not seem to be affected due to the roadway conversion.

Traffic Speeds

- In general, traffic speeds also decreased after the roadway conversion. The speed reductions ranged between 5 mph and 9 mph, or about 14% to 24%.